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Outcomes of Median Arcuate Ligament Release: A Single Institution Retrospective Review

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ABSTRACT

Objectives: Median arcuate ligament syndrome (MALS) is an uncommon diagnosis that is often associated with variable clinical presentation and inconsistent response to treatment. Due to the nature of MALS, the optimal treatment modality and predictors of outcomes remain unclear.

Methods: A retrospective review was performed of all median arcuate ligament release (MALR) procedures at a single academic institution between 2000-2020. Variables examined included patient demographics, symptom characteristics, operative technique (open, robotic, laparoscopic), patient symptoms prior to release, symptom relief within 1 year, and recurrence of symptoms between release and last clinical follow-up.

Results: During the study period, 47 patients (75% female, mean age 42.1 years) underwent MALR with 19 (36%) robotic, 18 (34%) open, 14 (26%) laparoscopic, and 2 (4%) laparoscopic converted to open procedures. Abdominal pain, weight loss, and nausea and vomiting were the most common symptoms. Postoperatively, 19 (40%) had complete symptom relief within one year, 18 (38%) had partial relief, and 10 (21%) had no symptom improvement. 6 were excluded due to loss of follow-up. Laparoscopic and open procedures had the highest rate of complete symptom relief by year one with 7 (58%) and 8 (50%) respectively. 21 (57%) patients had recurrence with the greatest rate of recurrence seen among laparoscopic (80%), compared to robotic (57%) and open (38%). Patients reporting a weight loss of 20 pounds or more prior to

surgery were more likely to have partial or complete symptom relief after one year compared to those reporting less than 20-pound weight loss (92% vs 64%). Furthermore, 84% of patients younger than 60 years old reported partial or complete symptom relief compared to only 56% of those older than 60.

Conclusion: MALS continues to be a rare disorder with widely variable surgical outcomes, requiring further study. While our patients presented with several gastrointestinal symptoms, the most common was postprandial pain. Our center employed laparoscopic, open, and robotic operative techniques with varying success rates, in terms of symptom relief and recurrence. Consistent with current literature, our study found greater surgical success among patients younger than 60 years regardless of operative technique. This suggests the need for better predictors to determine which patients are the most likely to have complete or prolonged remission of symptoms following MALR.

INTRODUCTION

Median arcuate ligament syndrome (MALS) is a rare disorder which is difficult to diagnose due to its nonspecific symptoms and presentation. MALS is clinically characterized by a triad of postprandial abdominal pain, weight loss, and often an abdominal bruit due to the compression of the celiac artery by the median arcuate ligament (MAL) (1).

Since the symptoms of MALS are nonspecific and overlap with several other potential causes of abdominal pain, it often becomes a diagnosis of exclusion. The challenge of identifying which patients will benefit from surgery is well documented in the available literature (2).

The current treatment of choice for symptomatic MALS patients is surgical decompression of the MAL, referred to as median arcuate ligament release (MALR) (3). Open surgical repair with decompression of the celiac artery and celiac plexus by division of the MAL fibers is a common treatment approach (3). Laparoscopic and robotic-assisted laparoscopic approaches have also been used successfully and are gaining popularity (4). While minimally invasive approaches are associated with less post-operative pain, postoperative outcomes vary (2, 5). Long-term outcomes after decompression vary, with a large proportion of patients having recurrence of symptoms (6). Given the rare nature of this disease and treatment, there is a paucity of studies looking at long-term follow-up after decompression. Little is known about which patients will respond to decompression and which ones will not.

This study aims to determine preoperative factors of patients who are at higher risk of symptom recurrence after MALR and compare short- and long-term outcomes of MALR approaches.

METHODS

We performed a retrospective review of all MALR procedures performed at the University of California, Los Angeles Ronald Reagan Medical Center from 2000 through 2020. Exclusion criteria were patients younger than 18 years of age, those who underwent MALR for reasons other than MALS, and patients with acute mesenteric ischemia. Data abstracted included demographic information, patient-related factors and comorbidities, diagnostic imaging information, surgical procedure information, pathology report findings, complications of surgery, and outcomes. The primary outcome was durable relief, defined as complete or partial improvement in symptoms without recurrence during the follow up period. Secondary outcomes were intra and post-operative complications. Freedom from symptom recurrence was calculated using the life-table method. Statistical analysis was performed using SAS 9.4 software (SAS Institute, Cary, NC). A p-value of <0.05 was considered statistically significant for all analyses. This study was approved by the UCLA Institutional Review Board (#20-001613).

RESULTS

Forty-seven patients that met inclusion criteria were identified. Mean age was 43 (SD = 19), and 75% (n=35) were female (Table 1). The most common presenting symptom was abdominal pain (n=44, 94%), most frequently reported in the epigastrium (n=31, 66%). Additional signs and symptoms included weight loss (n=28, 60%), nausea and vomiting (n=23, 49%), food fear (n=18, 38%), and diarrhea (n=8, 17%). This cohort had a high proportion of prior psychiatric diagnoses (n=20, 43%). Other common comorbidities included gastroesophageal reflux disease (n=18, 38%) and 30% (n=14) of patients used opioids for pain relief prior to surgery.

Diagnostic imaging in the pre-operative period most frequently was done via MRA (n=22, 47%) and CTA (n=19, 40%) (Table 2). While the vast majority completed either or both MRA and CTA, there were eight patients who did not undergo either of these types of diagnostic studies. Of those eight, two underwent conventional angiograms, two underwent duplex ultrasound, one did an upper GI series, one had a liver duplex ultrasound, and the remaining two were unknown (Table 3). Prior to MALR, there was a total of 20 diagnostic procedures performed for the same symptoms. Two patients underwent celiac plexus block with partial improvement of symptoms.

All patients underwent either laparoscopic, open, or robotic MALR (laparoscopic, n=12; open, n=16; robotic, n=17). Two laparoscopic procedures were converted to open; one was a celiac artery transaction that required open surgical repair with patch angioplasty of the celiac artery, and the other was converted due to extensive adhesions. 40% (n=19) of cases involved both general and vascular surgeons, 30% (n=14) were done by vascular surgeons alone, and 26% (n=12) were done by general surgeons.

Open procedures had the longest average operative times (246 min, SD=161) and highest estimated blood loss (151 cc) compared to laparoscopic (204 min, SD=53, 100 cc) and robotic (141 min +/- 69, 15 cc). Postoperatively, there were seven cases of ileus, five of which occurred in patients who underwent open release. Patients did not have any postoperative myocardial infarction, return to operating room for bleeding, pulmonary embolism, or wound complications. There was no mortality.

Thirty-seven patients (79%) reported immediate postoperative symptom relief, of which 19 (40%) were complete relief and 18 (39%) were partial relief. This included 10 out of 12 patients in the laparoscopic group (83%), 14 out of 17 in the robotic group (82%), and 13 out of 16 in the open group (81%) (Figure 1). Of the patients who had immediate postoperative improvement, 21 (57%) reported recurrence of symptoms. At 12 months postoperatively, 37% of patients had durable symptom relief (Figure 2). The majority of symptom recurrence occurred within the first 100 days post-operatively.

Univariate analysis was performed of all pre-operative and intra-operative variables and symptom recurrence, including demographics, co-morbidities, symptoms, diagnostic imaging, and no variables were significantly associated with symptom recurrence other than operative approach. There were no variables that trended toward significance with a $p<0.1$. Thus, no multivariable analysis was performed.

DISCUSSION

MALS is a rare disease and the etiology of pain associated with MALS is not fully understood. There are 2 main theories: 1) mesenteric ischemia and 2) nerve dysfunction (2, 7). Mesenteric ischemia is thought to be caused by compression of the celiac artery, leading to the symptoms of MALS (7). This unlikely fully explains the symptoms given the extensive collateral blood supply to the mesentery from other mesenteric vessels (8). The other proposed mechanism for MALS is due to celiac plexus nerve dysfunction from compression by the median arcuate ligament, leading to pain from entrapped ganglia and altered gastric motility (2).

While compression of celiac artery is observed in up to 25% of patients on computed tomography scan (CT), clinically symptomatic MALS is very rare (1). Patients are generally young females between 30 and 50 years of age who have had extensive workup for abdominal pain. Abdominal pain is typically located in the epigastric area and worsens after food intake. There are no unique physical exam findings in MALS, however, an epigastric bruit may be observed in up to 35% of the symptomatic patients (2).

Our single center experience demonstrates overall poor durable symptom relief after median arcuate ligament release and variable durable symptom relief across all operative techniques, consistent with the literature. The comorbidities in our patient population were comparable to previous studies. The rates of GERD and comorbid psychiatric illness were similar to a study of 100 patients who underwent open or laparoscopic release, of which 35% had GERD and 37%

had a history of psychiatric illness (9). Initial symptom relief following MALR among our patients was consistent with the literature (83-85%) (2, 9). However, our population had somewhat higher recurrence rates and lower durable relief at one year post-operatively. Prior studies have reported recurrence to be 6-18% and relief of symptoms at year 1 to be 80-93% (2, 9, 10). However, these studies vary in operative approach, duration of follow up, measures of relief, and study design. This may also be accounted for by a higher complexity of patients that may have been referred to our institution.

Our study was limited by the nature of retrospective review. Specifically, we did not measure a validated patient-reported outcome to assess pre- and post- operative symptoms, which has been used by other investigators. Additionally, individual surgeon technique or institutional-based techniques may have changed over time. We had to exclude several patients that were lost to follow-up shortly after surgery. The single-institution sample limits our ability to make comparisons and draw meaningful conclusions. For example, while incidence of symptom recurrence may appear to vary significantly by operative approach, this is due to the small sample size in each group with the absolute numerical difference between groups being quite small.

Future studies by the VLFDC will help capture a wide array of practice patterns and have sufficient power to make comparisons within a cohort of MALS patients – something that is difficult to do with singe-center studies given the rarity of this disease.

CONCLUSION

Surgical treatment of MALS in our population appears to have variable durable symptom relief. Patients most commonly presented with abdominal pain, weight loss, and nausea and vomiting. Approximately three-fourths of patients had immediate improvement in symptoms postoperatively but only a third of our cohort achieved durable relief. It is unclear if one operative approach is superior. A multi-institutional study is currently underway to further investigate characteristics of patients who are most likely to have durable relief and which operative approach may be optimal.

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Table 1. Demographics and clinical characteristics

Demographics	**Total** (n=47)
Mean age – years	42.8 ± 18.5
Female sex – no. (%)	35 (74.5)
Non-Hispanic Caucasian – no. (%)	37 (78.7)
Operative Technique	
Robotic	17 (36.2)
Open/laparotomy	16 (34.0)
Laparoscopic	12 (25.5)
Laparoscopic converted to open	2 (4.3)
Clinical Characteristics	
Pain	44 (94)
Weight loss	28 (60)
Nausea/Vomiting	23 (49)
Food fear	18 (38)
Diarrhea	8 (17)
Positional pain	6 (13)
Total parenteral nutrition (TPN)	4 (9)
Dysphagia	3 (6)
Abdominal bruit	2 (4)

Table 2. Preoperative Imaging Studies

Imaging Modality	**Total** (n=47)
MR angiogram	22 (47)
CT angiogram	19 (40)
Upper Endoscopy	12 (26)
Duplex Ultrasound w/ breathing	10 (21)
Upper GI series	8 (17)
Duplex Ultrasound w/o breathing	6 (13)
Angiogram w/ breathing	4 (9)
Angiogram w/o breathing	4 (9)
Other	3 (6)
Colonoscopy	2 (4)
Unknown	2 (4)
Capsule endoscopy	1 (2)

Table 3. Diagnostic studies done for patients who did not complete pre-operative MRA or CTA

Imaging Modality	**Total** (n=8)

Duplex Ultrasound w/ breathing	1
Duplex Ultrasound w/o breathing	1
Upper GI series	1
Angiogram w/ breathing	1
Angiogram w/o breathing	1
Liver duplex ultrasound	1
Unknown	2